FEATURES
- Passive; no dc bias required
- Conversion loss
  - 8 dB typical for 10 GHz to 18 GHz
  - 9 dB typical for 18 GHz to 26 GHz
- LO to RF isolation: 40 dB
- Input IP3: 19 dBm typical for 18 GHz to 26 GHz
- Wide IF bandwidth: dc to 8 GHz
- RoHS compliant, 12-terminal, 3 mm × 3 mm, ceramic LCC package: 9 mm²

APPLICATIONS
- Point to point radios
- Point to multipoint radios and very small aperture terminals (VSATs)
- Test equipment and sensors
- Military end use

GENERAL DESCRIPTION
The HMC260ALC3B is a general-purpose, double balanced, monolithic microwave integrated circuit (MMIC) mixer housed in a leadless, Pb-free, RoHS compliant LCC package. The device can be used as an upconverter or downconverter in the 10 GHz to 26 GHz frequency range. The HMC260ALC3B mixer requires no external components or matching circuitry.

The HMC260ALC3B provides local oscillator (LO) to radio frequency (RF) and LO to intermediate frequency (IF) suppression due to optimized balun structures. The mixer operates with LO amplitude levels between 9 dBm and 15 dBm. The HMC260ALC3B eliminates the need for wire bonding, allowing the use of surface-mount manufacturing techniques.
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# REVISION HISTORY

1/2018—Revision 0: Initial Version
SPECIFICATIONS

Ambient temperature ($T_A$) = 25°C, IF = 1000 MHz, LO = 13 dBm, upper sideband. All measurements performed as a downconverter on the evaluation printed circuit board (PCB), unless otherwise noted.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Test Conditions/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>FREQUENCY RANGE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RF</td>
<td></td>
<td>10</td>
<td>26</td>
<td></td>
<td>GHz</td>
<td></td>
</tr>
<tr>
<td>LO Input</td>
<td></td>
<td>10</td>
<td>26</td>
<td></td>
<td>GHz</td>
<td></td>
</tr>
<tr>
<td>IF</td>
<td></td>
<td>dc</td>
<td>8</td>
<td></td>
<td>GHz</td>
<td></td>
</tr>
<tr>
<td>LO AMPLITUDE</td>
<td></td>
<td>9</td>
<td>13</td>
<td>15</td>
<td>dBm</td>
<td></td>
</tr>
</tbody>
</table>

10 GHz TO 18 GHz PERFORMANCE

Downconverter
- Conversion Loss 8 10 dB
- Single Sideband Noise Figure SSB NF 8 dB
- Input Third-Order Intercept IIP3 13 18 dBm
- Input 1 dB Compression Point IP1dB 9.5 dBm
- Input Second-Order Intercept IIP2 43 dBm

Upconverter IF IN = 1000 MHz
- Conversion Loss 7 dB
- Input Third-Order Intercept IIP3 18 dBm
- Input 1 dB Compression Point IP1dB 7 dBm

Isolation
- RF to IF 14 21 dB
- LO to RF 40 dB
- LO to IF 25 35 dB

18 GHz TO 26 GHz PERFORMANCE

Downconverter
- Conversion Loss 9 12 dB
- Single Sideband Noise Figure SSB NF 10 dB
- Input Third-Order Intercept IIP3 18 23 dBm
- Input 1 dB Compression Point IP1dB 13 dBm
- Input Second-Order Intercept IIP2 46 dBm

Upconverter IF IN = 1000 MHz
- Conversion Loss 8 dB
- Input Third-Order Intercept IIP3 19 dBm
- Input 1 dB Compression Point IP1dB 8.5 dBm

Isolation
- RF to IF 25 35 dB
- LO to RF 40 dB
- LO to IF 30 43 dB
**ABSOLUTE MAXIMUM RATINGS**

Table 2.  
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF Input Power</td>
<td>25 dBm</td>
</tr>
<tr>
<td>LO Input Power</td>
<td>27 dBm</td>
</tr>
<tr>
<td>IF Input Power</td>
<td>25 dBm</td>
</tr>
<tr>
<td>IF Source/Sink Current</td>
<td>3 mA</td>
</tr>
<tr>
<td>Peak Reflow Temperature</td>
<td>260°C</td>
</tr>
<tr>
<td>Continuous Power Dissipation, $P_{Diss}$ ($T_a = 85°C$, Derate 5 mW/°C Above 85°C)</td>
<td>260 mW</td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>−40°C to +85°C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>−65°C to +150°C</td>
</tr>
<tr>
<td>Lead Temperature Range</td>
<td>−65°C to +150°C</td>
</tr>
<tr>
<td>Electrostatic Discharge (ESD) Sensitivity</td>
<td></td>
</tr>
<tr>
<td>Human Body Model</td>
<td>500 V</td>
</tr>
<tr>
<td>Field Induced Charged Device Model</td>
<td>1000 V</td>
</tr>
</tbody>
</table>

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

**THERMAL RESISTANCE**

Thermal performance is directly linked to printed circuit board (PCB) design and operating environment. Careful attention to PCB thermal design is required.

$\theta_J$ is the natural convection junction to ambient thermal resistance measured in a one cubic foot sealed enclosure. $\theta_{JC}$ is the junction to case thermal resistance.

Table 3. Thermal Resistance

<table>
<thead>
<tr>
<th>Package Type</th>
<th>$\theta_{JA}$</th>
<th>$\theta_{JC}$</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-12-4(^1)</td>
<td>120</td>
<td>200</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

\(^1\) See JEDEC standard JESD51-2 for additional information on optimizing the thermal impedance (PCB with 3 x 3 vias).

**ESD CAUTION**

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.
PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

Table 4. Pin Function Descriptions

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Mnemonic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 3, 4, 6, 7, 9</td>
<td>GND</td>
<td>Ground. These pins and package bottoms connect to RF/dc ground.</td>
</tr>
<tr>
<td>2</td>
<td>LO</td>
<td>Local Oscillator Port. This pin is ac-coupled and matched to 50 Ω.</td>
</tr>
<tr>
<td>5</td>
<td>IF</td>
<td>Intermediate Frequency Port. This pin is dc-coupled. For applications, not requiring operation to dc, dc block this port externally using a series capacitor of a value chosen to pass the necessary IF frequency range. For operation to dc, this pin must not source or sink more than 3 mA of current or die malfunction and possible die failure may result. See Figure 5 for the interface schematic.</td>
</tr>
<tr>
<td>8</td>
<td>RF</td>
<td>Radio Frequency Port. This pin is ac-coupled and matched to 50 Ω.</td>
</tr>
<tr>
<td>10 to 12</td>
<td>NIC</td>
<td>Not Internally Connected. These pins can be connected to RF/dc ground. Device performance is not affected.</td>
</tr>
<tr>
<td></td>
<td>EPAD</td>
<td>Exposed Pad. The exposed pad must be connected to RF/dc ground.</td>
</tr>
</tbody>
</table>

INTERFACE SCHEMATICS

Figure 3. GND Interface Schematic

Figure 4. LO Interface Schematic

Figure 5. IF Interface Schematic

Figure 6. RF Interface Schematic
TYPICAL PERFORMANCE CHARACTERISTICS

DOWNCONVERTER PERFORMANCE

Downconverter performance at IF = 1000 MHz, upper sideband (low-side LO).

Figure 7. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 13 dBm

Figure 8. Input IP3 vs. RF Frequency at Various Temperatures, LO = 13 dBm

Figure 9. Noise Figure vs. RF Frequency at Various Temperatures, LO = 13 dBm

Figure 10. Conversion Gain vs. RF Frequency at Various LO Power Levels, TA = 25°C

Figure 11. Input IP3 vs. RF Frequency at Various LO Power Levels, TA = 25°C

Figure 12. Noise Figure vs. RF Frequency at Various LO Power Levels, TA = 25°C
**Downconverter P1dB and IP2**

IF = 1000 MHz, upper sideband (low-side LO).

**Figure 13.** Input P1dB vs. RF Frequency at Various Temperatures, LO = 13 dBm

**Figure 14.** Input IP2 vs. RF Frequency at Various Temperatures, LO = 13 dBm

**Figure 15.** Input P1dB vs. RF Frequency at Various LO Power Levels, TA = 25°C

**Figure 16.** Input IP2 vs. RF Frequency at Various LO Power Levels, TA = 25°C
UPCONVERTER PERFORMANCE

Upconverter performance at input intermediate frequency (IF_{in}) = 1000 MHz, upper sideband (low-side LO).

Figure 17. Conversion Gain vs. RF Output (RF_{out}) Frequency at Various Temperatures, LO = 13 dBm

Figure 20. Conversion Gain vs. RF_{out} Frequency at Various LO Power Levels, T_A = 25°C

Figure 18. Input IP3 vs. RF_{out} Frequency at Various Temperatures, LO = 13 dBm

Figure 21. Input IP3 vs. RF_{out} Frequency at Various LO Power Levels, T_A = 25°C

Figure 19. Input P1dB vs. RF_{out} Frequency at Various Temperatures, LO = 13 dBm

Figure 22. Input P1dB vs. RF_{out} Frequency at Various LO Power Levels, T_A = 25°C
ISOLATION AND RETURN LOSS

Downconverter performance at IF = 1000 MHz, upper sideband.

Figure 23. LO to RF Isolation vs. RF Frequency at Various Temperatures, LO = 13 dBm

Figure 24. LO to IF Isolation vs. RF Frequency at Various Temperatures, LO = 13 dBm

Figure 25. RF to IF Isolation vs. RF Frequency at Various Temperatures, LO = 17 GHz, TA = 25°C
Figure 29. LO Return Loss vs. LO Frequency, $T_A = 25^\circ C$, LO = 13 dBm

Figure 30. RF Return Loss vs. RF Frequency at Various LO Powers, $T_A = 25^\circ C$

Figure 31. IF Return Loss vs. IF Frequency at Various LO Powers, LO = 17 GHz, $T_A = 25^\circ C$
IF BANDWIDTH—DOWNCONVERTER

Upper sideband, RF = 20 GHz.

Figure 32. Conversion Gain vs. IF Frequency at Various Temperatures, LO = 13 dBm

Figure 33. Input IP3 vs. IF Frequency at Various Temperatures, LO = 13 dBm

Figure 34. Conversion Gain vs. IF Frequency at Various LO Power Levels, TA = 25°C

Figure 35. Input IP3 vs. IF Frequency at Various LO Power Levels, TA = 25°C
**IF BANDWIDTH—UPCONVERTER**

Upper sideband, RF_{OUT} = 20 GHz.

![Graph showing conversion gain vs. IF_{IN} frequency at various temperatures.](image1)

**Figure 36. Conversion Gain vs. IF_{IN} Frequency at Various Temperatures, LO = 13 dBm**

![Graph showing input IP3 vs. IF_{IN} frequency at various temperatures.](image2)

**Figure 37. Input IP3 vs. IF_{IN} Frequency at Various Temperatures, LO = 13 dBm**

![Graph showing conversion gain vs. IF_{IN} frequency at various LO power levels.](image3)

**Figure 38. Conversion Gain vs. IF_{IN} Frequency at Various LO Power Levels, T_A = 25°C**

![Graph showing input IP3 vs. IF_{IN} frequency at various LO power levels.](image4)

**Figure 39. Input IP3 vs. IF_{IN} Frequency at Various LO Power Levels, T_A = 25°C**
**SPURIOUS AND HARMONICS PERFORMANCE**

Mixer spurious products are measured in dBc from either the RF pin or IF pin output power level. N/A means not applicable.

**Downconverter M × N Spurious Outputs**

Spur values are \((M \times RF) - (N \times LO)\).

RF = 18 GHz at −10 dBm, LO = 17 GHz at 13 dBm.

<table>
<thead>
<tr>
<th>M × RF</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>N × LO</td>
<td>N/A</td>
<td>7</td>
<td>19</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>0</td>
<td>34</td>
<td>42</td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>67</td>
<td>71</td>
<td>66</td>
<td>71</td>
<td>68</td>
</tr>
<tr>
<td>3</td>
<td>N/A</td>
<td>63</td>
<td>72</td>
<td>84</td>
<td>73</td>
</tr>
<tr>
<td>4</td>
<td>N/A</td>
<td>N/A</td>
<td>64</td>
<td>74</td>
<td>77</td>
</tr>
</tbody>
</table>

**Upconverter M × N Spurious Outputs**

Spur values are \((M \times \text{IFIN}) + (N \times LO)\).

\(\text{IFIN} = 1000 \text{ MHz at } -10 \text{ dBm, LO = 17 GHz at 13 dBm}\).

<table>
<thead>
<tr>
<th>M × \text{IFIN}</th>
<th>N × LO</th>
</tr>
</thead>
<tbody>
<tr>
<td>−5</td>
<td>81 77 73</td>
</tr>
<tr>
<td>−4</td>
<td>83 78 71</td>
</tr>
<tr>
<td>−3</td>
<td>73 64 72</td>
</tr>
<tr>
<td>−2</td>
<td>55 42 66</td>
</tr>
<tr>
<td>−1</td>
<td>18 0 28</td>
</tr>
<tr>
<td>0</td>
<td>0 9.5 17</td>
</tr>
<tr>
<td>1</td>
<td>18 0 40</td>
</tr>
<tr>
<td>2</td>
<td>55 45 67</td>
</tr>
<tr>
<td>3</td>
<td>74 66 64</td>
</tr>
<tr>
<td>4</td>
<td>81 74 66</td>
</tr>
<tr>
<td>5</td>
<td>80 74 68</td>
</tr>
</tbody>
</table>
THEORY OF OPERATION

The HMC260ALC3B is a general-purpose, double balanced mixer that can be used as an upconverter or a downconverter from 10 GHz to 26 GHz.

When used as a downconverter, the HMC260ALC3B downconverts RF between 10 GHz and 26 GHz to IF between dc and 8 GHz.

When used as an upconverter, the mixer upconverts IF between dc and 8 GHz to RF between 10 GHz and 26 GHz.

The mixer performs well with LO drives of 9 dBm or greater, and it provides LO to RF and LO to IF suppression due to optimized balun structures. The ceramic LCC package eliminates the need for wire bonding and is compatible with high volume, surface-mount manufacturing techniques.
APPLICATIONS INFORMATION

TYPICAL APPLICATION CIRCUIT

Figure 40 shows the typical application circuit for the HMC260ALC3B. The HMC260ALC3B is a passive device and does not require any external components. The LO and RF pins are internally ac-coupled. The IF pin is internally dc-coupled. When IF operation to dc is not required, use of an external series capacitor of a value chosen to pass the necessary IF frequency range is recommended. When IF operation to dc is required, do not exceed the IF source and sink current rating specified in the Absolute Maximum Ratings section.

EVALUATION PCB INFORMATION

Use RF circuit design techniques for the circuit board. Ensure that signal lines have 50 Ω impedance. Connect the package ground leads and the exposed pad directly to the ground plane (see Figure 41). Use a sufficient number of via holes to connect the top and bottom ground planes. The evaluation circuit board shown in Figure 41 is available from Analog Devices, Inc., upon request.

Table 5. Bill of Materials

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1, J2</td>
<td>PCB mount SRI 2.92 mm connectors</td>
</tr>
<tr>
<td>J3</td>
<td>PCB mount Johnson SMA connector</td>
</tr>
<tr>
<td>U1</td>
<td>HMC260ALC3B</td>
</tr>
<tr>
<td>PCB1</td>
<td>117611 evaluation board on Rogers 4350</td>
</tr>
</tbody>
</table>

1 117611 is the raw bare PCB identifier. Reference 109728 when ordering the complete evaluation PCB.
**OUTLINE DIMENSIONS**

![Outline Dimensions Diagram](image)

**Figure 42. 12-Terminal Ceramic Leadless Chip Carrier (LCC) (E-12-4)**  
*Dimensions shown in millimeters*

**ORDERING GUIDE**

<table>
<thead>
<tr>
<th>Model</th>
<th>Temperature Range</th>
<th>MSL Rating</th>
<th>Package Description</th>
<th>Package Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMC260ALC3B</td>
<td>−40°C to +85°C</td>
<td>MSL3</td>
<td>12-Terminal LCC</td>
<td>E-12-4</td>
</tr>
<tr>
<td>HMC260ALC3BTR</td>
<td>−40°C to +85°C</td>
<td>MSL3</td>
<td>12-Terminal LCC</td>
<td>E-12-4</td>
</tr>
<tr>
<td>HMC260ALC3BTR-R5</td>
<td>−40°C to +85°C</td>
<td>MSL3</td>
<td>12-Terminal LCC</td>
<td>E-12-4</td>
</tr>
<tr>
<td>EV1HMC260ALC3B</td>
<td>−40°C to +85°C</td>
<td>MSL3</td>
<td>Evaluation PCB</td>
<td></td>
</tr>
</tbody>
</table>

1 All models are RoHS compliant devices.  
2 The peak reflow temperature is 260°C. See Table 2 in the Absolute Maximum Ratings section.

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D13884-0-1/18(0)